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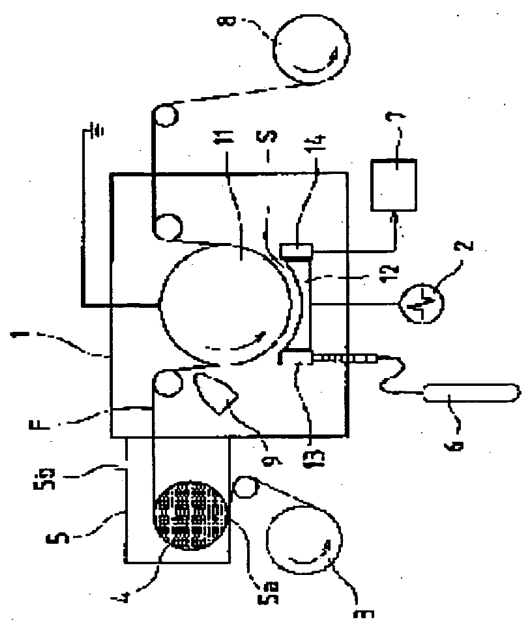
(54) DISCHARGE PLASMA TREATING METHOD

(57)Abstract:
PROBLEM TO BE SOLVED: To form a thin film high in transparency on the surface of a base material with high efficiency.
SOLUTION: In a method in which the space between counter electrodes 11 and 12 arranged under pressure in the vicinity of the atmospheric pressure is applied with the electric field to generate discharge plasma and the discharge plasma is used to form a thin film on the surface of a base material F, a previous stage of discharge plasma treatment is provided with a base material heating and drying device (e.g. a heating roll 4). The region from the base material drying device to the discharge plasma treatment part is coated with a vessel 5, and the inside of this vessel 5 is filled with dry gas and/or heating gas so that, before the treatment of the base material F with discharge plasma, the base material F is dried and, moreover, during a base material transport to a discharge plasma treating section, the humidity reabsorption of the base material F is prevented.



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CLAIMS

[Claim(s)]
[Claim 1] Where it has arranged the counterelectrode under the pressure near the atmospheric pressure and a base material is arranged between this counterelectrode In the approach of making generate the discharge plasma and forming a thin film on the surface of a base material using the discharge plasma by impressing electric field between counterelectrodes, while forming a base material dryer in the pre-stage of discharge plasma treatment The discharge plasma treatment approach characterized by filling the interior of a bonnet and this container with the container which has base material conveyance opening and gas input for from that base material dryer to the discharge plasma treatment section by the dry gas and/or heating gas.
[Claim 2] Discharge plasma treatment equipment according to claim 1 characterized by setting at least to the direct anterior part of the roll electrode, and carrying out preheating of the base material while using a roll electrode for discharge plasma treatment.
[Claim 3] The discharge plasma treatment approach according to claim 2 characterized by performing preheating of a base material with a hot blast dryer.
[Claim 4] The discharge plasma treatment approach according to claim 2 or 3 characterized by the preheating temperature of a base material being the electrode temperature of less than **5 degrees C.
[Claim 5] The discharge plasma treatment approach according to claim 1 or 2 characterized by the dew-point of a dry gas being -15 degrees C or less.
[Claim 6] The discharge plasma treatment approach according to claim 1, 2, or 5 characterized by the temperature of heating gas being 35 degrees C or more and less than 100 degrees C.
[Claim 7] The discharge plasma treatment approach according to claim 1, 2, 5, or 6 that a base material dryer is characterized by being a heating roller.
[Claim 8] The discharge plasma treatment approach according to claim 7 that temperature of a heating roller is characterized by being 50 degrees C or more and less than 100 degrees C.

[Translation done.]

* NOTICES *

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1.This document has been translated by computer. So the translation may not reflect the original precisely.
2.**** shows the word which can not be translated.
3.In the drawings, any words are not translated.

DETAILED DESCRIPTION

[Detailed Description of the Invention]
[0001]
[Field of the Invention] This invention relates to the so-called ordinary pressure discharge plasma treatment approach of processing a base material using the discharge plasma generated under the pressure near the atmospheric pressure.
[0002]
[Description of the Prior Art] The thin film formation approach of having used from the former the plasma produced by the glow discharge under low voltage conditions is put in practical use. however, a vacuum housing, vacuum devices, etc. are required for the thin film formation under these low voltage conditions, and it processes in batch -- ** -- it needs to be alike and it is necessary to destroy the vacuum of a vacuum housing and to newly perform vacuum suction -- etc. -- it became expensive also with the initial cost and the running cost, and since it was industrially disadvantageous, it was not applied only to processing of expensive articles, such as electronic parts and an optic.
[0003] In order to solve such a problem, the method of using the discharge plasma under the pressure near the atmospheric pressure is proposed conventionally. For example, the method of processing by the plasma generated under the ambient atmosphere near [which the method of processing using the plasma generated under the mixed ambient atmosphere of the helium of the pressure near the atmospheric pressure and a ketone is indicated by JP,2-48626,A, and becomes an argon list from an acetone and/or helium at JP,4-74525,A] the atmospheric pressure is indicated.
[0004] However, each above-mentioned approach is an approach of generating the plasma in the gas ambient atmosphere containing helium or a ketone, and processing of helium itself being expensive, and it being industrially disadvantageous, and forming an inorganic thin film a gas ambient atmosphere's not only being limited, but is substantially impossible.
[0005] Then, by impressing electric field between counterelectrodes in the ambient atmosphere which contains metallic compounds under the pressure near the atmospheric pressure, the discharge plasma is generated and these people are TiO2. The thin film formation approach which forms metal content thin films, such as a thin film, is already proposed.
[0006]
[Problem(s) to be Solved by the Invention] By the way, the high ingredient of hydrolysis nature, for example, tetrapod iso proxy titanate, is used, and it is TiO2 by the discharge plasma. When forming a thin film, if the water content of a discharge plasma treatment base material is too low, a membrane formation rate will become slow. Moreover, when water content is too high, a reaction progresses superfluously and it is TiO2 to a membrane formation front face. Floc deposits, the film milks and there is a problem that transparency worsens.
[0007] even if this invention is the case where a thin film is formed in the base material which was made in view of such the actual condition, and has hygroscopicity -- TiO2 etc. -- it aims at offer of the discharge plasma treatment approach which can form a transparence metallic-oxide thin film efficiently [are uniform thickness and].
[0008]
[Means for Solving the Problem] It is in the condition which the discharge plasma treatment approach of this invention has arranged the counterelectrode under the pressure near the atmospheric pressure, and arranged the base material between this counterelectrode. In the approach of making generate the discharge plasma and forming a thin film on the surface of a base material using the discharge plasma by impressing electric field between counterelectrodes, while forming a base material dryer in the pre-stage of discharge plasma treatment It characterizes by filling the interior of

a bonnet and this container with the container which has base material conveyance opening and gas input for from that base material dryer to the discharge plasma treatment section by the dry gas and/or heating gas.

[0009] Thus, a thin film with high transparency can be efficiently formed in a base material front face by drying a base material, before processing the base material which performs discharge plasma treatment, and making water content into a predetermined rate by preventing re-moisture absorption of a base material in the base material conveyance section by the discharge plasma treatment section further.

[0010] In addition, in this invention, the pressure near the atmospheric pressure means the pressure of 100 - 800Torr, pressure regulation is easy and it is desirable [a pressure] to consider as the pressure range of 700 - 780Torr which becomes easy [an equipment configuration] especially.

[0011] In this invention, a heating roller, a hot blast dryer, an infrared heater, a microwave heating device, etc. are mentioned as a dryer used for desiccation of a base material.

[0012] Moreover, the approach of drying the environment of the base material conveyance section (between dryer - discharge plasma treatment fields) as an approach of preventing re-moisture absorption of a base material, so that it may become predetermined temperature and may become heating (heating method) or below humidity (desiccation method) is mentioned.

[0013] Here, although the values which should be set up with the matter used as the class of base material to be used and a raw material differ, tetrapod iso proxy titanium is used for the water content of a base material, for example on a triacetyl cellulose film (TAC), and it is TiO_2. When forming a thin film, it is necessary to dry the base material water content which is 1.5 - 2.5 % of the weight in the usual environment so that it may become 0.3 - 1.0% of the weight.

[0014] In this case, the case where a heating roller is used as a desiccation means has the highest effectiveness, and in order to prevent re-moisture absorption, the approach of making environmental temperature of the base material conveyance section -15 degrees C or less of dew-points is suitable [50 degrees C or more less than 100 degrees C are suitable for that temperature, and] for it. If drying efficiency is bad in desiccation roll temperature being less than 50 degrees C and it exceeds 100 degrees C, in addition to water content being too low and a membrane formation rate falling, when a base material is plastics, thermal expansion will become large, and it will lead to the distortion of a base material etc.

[0015] If neither of a heating method and a desiccation method of the cases affects a base material at all and does not adhere on a base material by a chemical reaction etc., anything, the gas used for preventing the resorption of a base material is good, and can mention air, nitrogen, an argon, oxygen, helium, neon, etc.

[0016] When a heating method is adopted by recalculation prevention, and the effectiveness decreases that environmental temperature is less than 35 degrees C, it exceeds 100 degrees C and a base material is plastics, the distortion of a base material will be caused. Moreover, when a desiccation method is adopted similarly, there is little the effectiveness that a dew-point is less than -15 degrees C.

[0017] However, when drying using a heating roller, even if the temperature is 50 degrees C or more and less than 100 degrees C, the wrinkle by the thermal expansion of a base material may enter on a heating roller. Once a wrinkle enters, when the peculiarity will stick, for example, it will use a roll electrode, the same wrinkle becomes easy to enter also on an electrode. If a wrinkle enters on a roll electrode, it becomes impossible to supply material gas crosswise [base material] at homogeneity, and the thickness of a thin film will become an ununiformity.

[0018] In this case, it is necessary to carry out preheating of the base material using a hot blast dryer, an infrared heater, a microwave heating device, etc., to make a base material expand thermally in the suitable range beforehand, and to prevent the thermal expansion on an electrode just before a roll electrode. Although the preheating temperature in this case changes with base materials, in the case of a TAC film (film thickness of 80 micrometers), a hot blast dryer is suitable, for example. The hot blast temperature in that case needs to be less than **5 degrees C in electrode temperature. Effectiveness is not acquired unless it is the within the limits.

[0019] In this invention, plastics, such as polyethylene, polypropylene, polystyrene, a polycarbonate, polyethylene terephthalate, polytetrafluoroethylene, acrylic resin, and triacetyl cellulose (TAC), etc. is mentioned as construction material of the base material with which discharge plasma treatment is performed.

[0020] As a counterelectrode applied to this invention, what consists of alloys, such as metal simple

substances, such as copper and aluminum, stainless steel, and brass, an intermetallic compound, etc. is mentioned.

[0021] A solid dielectric is stuck to the opposed face of a counterelectrode which is either at least, and it arranges. since [under the present circumstances,] arc discharge will arise from there if there is a part where electrodes counter directly, without being alike and being covered with a solid dielectric -- an opposed face -- perfect -- a wrap -- a solid dielectric is arranged like. Although the shape of the shape of a sheet and a film has as the configuration of a solid dielectric, since high tension will be taken to generate the discharge plasma if too thick, dielectric breakdown will happen at the time of electrical-potential-difference impression if too thin and arc discharge occurs, it is 0.05-4mm that thickness is 0.01-4mm desirable still more preferably.

[0022] As a solid dielectric, multiple oxides, such as metallic oxides, such as plastics, such as polytetrafluoroethylene and polyethylene terephthalate, glass, a silicon dioxide, an aluminum oxide, a zirconium dioxide, and a titanium dioxide, and barium titanate, etc. are mentioned.

[0023] A solid dielectric may be directly formed and used for a coat condition on conductors, such as carbon steel, or an electrode. In this case, although the thinner one tends to generate the discharge plasma, since arc discharge arises in order to exceed the withstand voltage of a coat, if too thin, dielectric loss will become large if too thick, it is hard to generate the discharge plasma, and it becomes high temperature or a crack arises on a coat, as for the thickness of a coat, for 10-1000 micrometers is desirable, and its 50-700 micrometers are more desirable. Since the discharge plasma from which the one where thickness is more uniform is obtained becomes homogeneity, a metallic-oxide coat is desirable.

[0024] Although it is better to consider as narrow space since it will become difficult to maintain discharge at the glow condition suitable for plasma treatment if inter-electrode spacing becomes large too much, when the reactant gas amount of supply and the transit stability of a base material are taken into consideration, 2-4mm is desirable.

[0025] Furthermore, the magnitude of an electrode is suitably determined in consideration of the travel speed of the processing time and a base material. Since the processing time is influenced by the plasma reaction rate, it changes with gas for processing.

[0026] Although the electric field impressed between counterelectrodes in this invention may be any of an alternating current wave or a pulse wave, if the pulse voltage of a high-speed standup is used especially, they can generate the glow discharge plasma of the suitable high density for membrane formation processing.

[0027] Although especially the pulse shape of the pulse voltage is not limited, an impulse mold which is illustrated to drawing 3 (A) and (B), a square wave mold which is illustrated to (C), a modulation mold which is illustrated to (D), etc. can be used. although that whose applied voltage is the repeat of positive/negative was illustrated to this drawing 7 -- one of forward or negative polar pulse voltages, and the so-called piece -- a wavelike pulse voltage may be impressed. In addition, a direct current may be superimposed in impression of a pulse voltage.

[0028] Ionization of the gas at the time of the pulse voltage impressed between counterelectrodes being plasma generating, so that the build up time and falling time amount of the pulse are short is performed efficiently. As for especially the standup of the pulse voltage impressed to inter-electrode, it is desirable to be referred to as 100 or less microseconds. If 100 microseconds is surpassed, a discharge condition will tend to shift to arc discharge, and will become unstable. Moreover, it is effective in the pulse electric field of such the high-speed rise time realizing the high discharge condition of electron density.

[0029] Although especially the falling time amount of a pulse voltage is not specified, a thing high-speed to the same extent as build up time is desirable, and is 100 or less microseconds more preferably. Moreover, although it starts and especially the minimum of /falling time amount does not limit, if a power unit etc. is taken into consideration, several 10ns or more is realistic. In addition, build up time here shall mean the time amount whose sense of electrical-potential-difference change is forward continuously, and falling time amount shall point out the time amount whose sense of electrical-potential-difference change is negative continuously.

[0030] As for the pulse electric field formed between counterelectrodes, the pulse shape, a standup, falling time amount, and a frequency may be modulated suitably. In addition, pulse electric field have a high frequency and the one where pulse width is shorter is suitable for high-speed continuation thin film formation.

[0031] As for the frequency of pulse electric field, it is desirable to consider as the range of 0.5kHz -

100kHz. If a thin film formation rate is too slow in it being less than 0.5kHz, it is not realistic and it exceeds 100kHz, it will become easy to generate arc discharge. The frequency of pulse electric field is 1kHz or more in the above-mentioned range more preferably.

[0032] Moreover, as for the pulse length in pulse electric field, it is desirable that it is 1 microsecond - 1000 microseconds, and it is 3 microseconds - 200 microseconds more preferably. Discharge becomes being less than 1 microsecond with an unstable thing, and if 1000 microseconds is exceeded, it will shift to arc discharge and will come to burn. Here, although pulse length means the continuation persistence time of one pulse shape in the pulse electric field by which ON-OFF is repeated and is pulse continuation timer pulse duty time amount in the wave of drawing 4 (A) as illustrated to drawing 8, the time amount including two or more pulses which ON continues is said in the wave of drawing 4 (B).

[0033] The reinforcement of the pulse electric field formed between counterelectrodes has the desirable range of 1 - 100 kV/cm. Processing takes time amount too much as it is less than 1 kV/cm, and if 1 - 100 kV/cm is exceeded, it will become easy to generate arc discharge.

[0034] The above pulse electric fields can be acquired according to the high-tension pulse power source which has the device changed into a pulse by the semiconductor device the turn-on time and whose turn-off time are 500 or less ns. This high-tension pulse power source becomes the direct-current-voltage feed zone which can supply a high-tension current, and a list from the pulse control section which changes said high voltage direct current to a high-tension pulse using the semiconductor device the turn-on time and whose turn-off time are 500 or less ns.

[0035]

[Example] First, the membrane formation equipment used for the example (example of a comparison) of this invention is typically shown in drawing 1 .

[0036] the membrane formation equipment shown in drawing 1 -- mainly -- a chamber 1 and the high-tension pulse power source 2 -- appearance is wound and carried out and it is constituted by a roll 3, a heating roller 4 and its container 5, the gas transfer unit 6 for processing, the vacuum pump (oil sealed rotary pump) 7, and the rolling-up roll 8 grade.

[0037] Inside the chamber 1, the roll electrode 11 and the curved-surface electrode 12 which counter mutually are arranged. Between this roll electrode 11 and the curved-surface electrode 12 (discharge space S), the pulse voltage from the high-tension pulse power source 2 is impressed. Moreover, the passage for circulation of cooling water (not shown) is formed in the interior of the roll electrode 11, and the base material F which runs while contacting this roll electrode 11 can be held to the temperature (for example, 60 degrees C) suitable for membrane formation. In addition, the passage for circulation is formed also like the curved-surface electrode 12.

[0038] A gas inlet 13 and the gas attraction opening 14 are formed in the interior of a chamber 1, the gas transfer unit 6 for processing is connected to the gas inlet 13, and the vacuum pump 7 for reduced pressure is connected to the gas attraction opening 14. Moreover, the hot blast dryer 9 is installed in the interior of a chamber 1 by at least the direct anterior part of the roll electrode 11.

[0039] And the heating roller 4 is arranged with the membrane formation equipment used for this example just before the pre-stage of discharge plasma treatment, i.e., the induction of the base material F of a chamber 1. The circumference of this heating roller 4 is covered with the container 5 which has base material conveyance opening 5a and gas input 5b. In addition, the environments inside a container 5 (temperature, humidity, etc.) can be set as the target conditions by introducing a dry gas and/or heating gas from gas input 5a.

[0040] Moreover, as shown in the sectional view (A), the bottom view (B), and C view drawing (C) of drawing 2 , the 1st room of the 2nd room of the gas inlet 13 used for this example is constituted by 120 with 110.

[0041] While 110 forms the 1st room of the gas input 112 where gas supply line G is connected to the end section of the longitudinal direction of the container 111 of the Nogata configuration The partition which becomes so narrow that it keeps away from the gas input 112 by forming a cam plate 113 on the diagonal line of a container 111 is formed. the gas which flowed from the gas input 112 is turbulent-flow-ized, and the consistency in the partition is equalized -- making -- the rate of flow -- abbreviation -- after deflecting the direction at the same time it considers as a uniform thing, it has structure which rectifies gas and blows off from the stoma group 114 of uniform a large number prepared near the edge of a container 111.

[0042] The 2nd room, 120 forms the slit 123 near the edge, and it is constituted so that the gas which came out of the 1st room of the stoma group 114 of 110 may turn around a dashboard 112,

may serve as a laminar flow from a slit 123 and may blow off in discharge space, while forming the dashboard 122 which has a uniform clearance in the interior of the container 121 of the Nogata configuration.

[0043] Next, the concrete example of the discharge plasma treatment approach of this invention is hereafter explained with the example of a comparison.

In the membrane formation equipment shown in <example 1> drawing 1 as a roll electrode 11 That to which coating (spraying process) of the solid dielectric with a thickness of 1mm with which the diameter of 400mm, die length of 750mm, and a front face consist of TiO2 20 % of the weight and aluminum2 O3 80 % of the weight is carried out is used. As a curved-surface electrode 12 Spacing of these rolls electrode 11 and the curved-surface electrode 12 was set to 2mm using the thing with a radius of curvature [of 202mm], and a die length of 750mm.

[0044] Moreover, the thing of the structure shown in drawing 2 was used for the gas inlet 13 which introduces material gas between the roll electrode 11 and the curved-surface electrode 12. Furthermore, while arranging the hot blast dryer 9 (operating temperature: **5 degrees C with an electrode temperature of 70 degrees C) for urging the thermal expansion of a base material F A heating roller 4 (the diameter of 400mm, die length of 759mm, the product made from stainless steel, contact die length of 700mm with a base material) and its container 5 were installed in the preceding paragraph of a chamber 1, and the base material F (TAC film: the Konica Corp. make, thickness of 80 micrometers) was contacted in it at discharge side 11a of the roll electrode 11.

[0045] furthermore, the tetrapod after exhausting the inside of a chamber 1 with a vacuum pump 7 to 10Torr -- iso -- the mixed gas of proxy titanium;0.2 volume % / argon;99.8 volume % was introduced in the chamber 1 from the gas inlet 13, and internal pressure was set to 760Torr(s). At this time, the interior of the container 5 of a heating roller 4 was filled with nitrogen gas (heating gas), and that dew-point was made into -20 degrees C, and temperature inside a container 5 was made into 20 degrees C.

[0046] and -- winding -- appearance -- carrying out -- a roll 3 -- rolling round -- between rolls 8 -- 10 kgf/m2 while making it run a base material F by travel-speed 0.5 m/min, applying tension -- the roll electrode 11 -- the transit direction of a base material F -- and it was made to correspond to the travel speed of a base material F, and was made to rotate Skin temperature of a heating roller 4 was made into 70 degrees C at this time.

[0047] Next, they are the pulse electric field (the build up time for 5 microseconds, the frequency of 4kHz, 50 microseconds of pulse width, peak value of 6kV) which show the roll electrode 11 and the curved-surface electrode 12 between the roll electrode 11 and the curved-surface electrode 12 at drawing 3 (A) in the condition of having set it as the 60-degree C condition with circulating water Discharge current consistency 2 mA/cm2 It impresses, the discharge plasma is generated and it is TiO2 to the front face of a base material F. The thin film was formed.

Except having made the environment inside [container 5] the <example 2> heating roller 4 into 40 degrees C, it is TiO2 to the front face of a base material F as the same as an example 1. The thin film was formed.

Except having made skin temperature of the <example 3> heating roller 4 into 90 degrees C, it is TiO2 to a base material F front face as the same as an example 1. The thin film was formed.

Except having made the environment inside [container 5] the <example 1 of comparison> heating roller 4 into 40% of humidity, it is TiO2 to the front face of a base material F as the same as an example 1. The thin film was formed.

Except having made skin temperature of the <example 2 of comparison> heating roller 4 into 25 degrees C, it is TiO2 to a base material F front face as the same as an example 1. The thin film was formed.

Except having made skin temperature of the <example 3 of comparison> heating roller 4 into 120 degrees C, it is TiO2 to a base material F front face as the same as an example 1. The thin film was formed.

It is TiO2 to a base material F front face as the same as an example 1 except having made skin temperature of -5 degrees C and a heating roller 4 into 35 degrees C for the dew-point inside [container 5] the <example 4 of comparison> heating roller 4. The thin film was formed.

Except having made the environment inside [container 5] the <example 5 of comparison> heating roller 4 into 120 degrees C, it is TiO2 to the front face of a base material F as the same as an example 1. The thin film was formed.

Except making operating temperature of the <example 6 of comparison> hot blast dryer 9 into 30

degrees C, it is TiO2 to the front face of a base material F as the same as an example 1. The thin film was formed.
Except making operating temperature of the <example 7 of comparison> hot blast dryer 9 into 80 degrees C, it is TiO2 to the front face of a base material F as the same as an example 1. The thin film was formed.
[0048] The following physical-properties assessment was performed about a base material and TiO2 thin film obtained by processing of each example of the above examples 1-3 and the examples 1-7 of a comparison. The result is shown in the following table 1.
- It measured using the refractive index and the thickness ellipsometer (Mizojiri Optical industrial company make, "Format BVA -36VM").
- Appearance assessment viewing estimated.
[0049] The degree of milkiness was evaluated about whenever [milkiness].
The degree 0 of milkiness: Transparency is high and adhesion of face powder and a milkiness part are not found.
[0050] The degree 1 of milkiness: Optical assessment is possible although a milkiness part is seen in part.
The degree 2 of milkiness: The whole has milked and optical assessment is impossible.
- It measured using base material water content water measurement equipment ("CA-06" by Mitsubishi Chemical).
[0051]
[A table 1]

	屈折率	膜厚 (nm)	外観		基材含水率 (重量%)
			白化度	その他	
実施例 1	2.08	135	0		0.7
実施例 2	2.02	140	0		0.7
実施例 3	2.01	115	0		0.6
比較例 1	1.95	150	1		1.2
比較例 2	-	-	2	屈折率、膜圧測定不能	1.6
比較例 3	2.07	35	0	成膜速度遅い、熱膨張跡有り	0.3
比較例 4	-	-	2	屈折率、膜圧測定不能	1.7
比較例 5	2.07	33	0	熱膨張跡有り	0.1
比較例 6	2.05	133	0	基材表面にしわ有り	0.7
比較例 7	2.05	128	0	基材表面にしわ有り	0.7

[0052] TiO2 obtained from the above result by processing of examples 1-3 Membrane formation conditions (thickness etc.) of a thin film are good, and it turns out that it excels also in transparency. Moreover, a refractive index is also known [good] by that is ****(ed). In addition, TiO2 by the reference value A refractive index is 2.15.
[0053]
[Effect of the Invention] In the approach of according to this invention, making generate the glow discharge plasma under the pressure near the atmospheric pressure, and forming a thin film in a base material front face using the discharge plasma, as explained above While forming a base material dryer in the pre-stage of discharge plasma treatment, with a container from that base material dryer to the discharge plasma treatment section by filling the interior of a bonnet and this container by the dry gas and/or heating gas Since water content is made into the predetermined rate by drying a base material and preventing re-moisture absorption of a base material in the base material conveyance section by the discharge plasma treatment section further, before processing the base material which performs discharge plasma treatment the case where a thin film is formed in the base material which has the hygroscopicity of a TAC film etc. -- the front face of the base material -- TiO2 etc. -- it is uniform thickness and a transparence metallic-oxide thin film can be formed efficiently.

[Translation done.]

* NOTICES *

DESCRIPTION OF DRAWINGS

[Brief Description of the Drawings]
[Drawing 1] It is drawing showing typically the configuration of the membrane formation equipment used with the gestalt of operation of this invention.
[Drawing 2] It is drawing showing the structure of the gas inlet installed in the membrane formation equipment shown in drawing 1 .
[Drawing 3] It is the electrical-potential-difference wave form chart showing the example of the pulse electric field impressed between counterelectrodes.
[Drawing 4] It is drawing showing the example of the pulse length of the pulse electric field impressed between counterelectrodes.
[Description of Notations]
1 Chamber
11 Roll Electrode
12 Curved-Surface Electrode
13 Gas Inlet
14 Gas Attraction Opening
2 High-Tension Pulse Power Source
3 It Begins to Wind and is Roll.
4 Heating Roller
5 Container
6 Gas Transfer Unit for Processing
7 Vacuum Pump
8 Rolling-Up Roll
9 Hot Blast Dryer
F Base material (TAC film)

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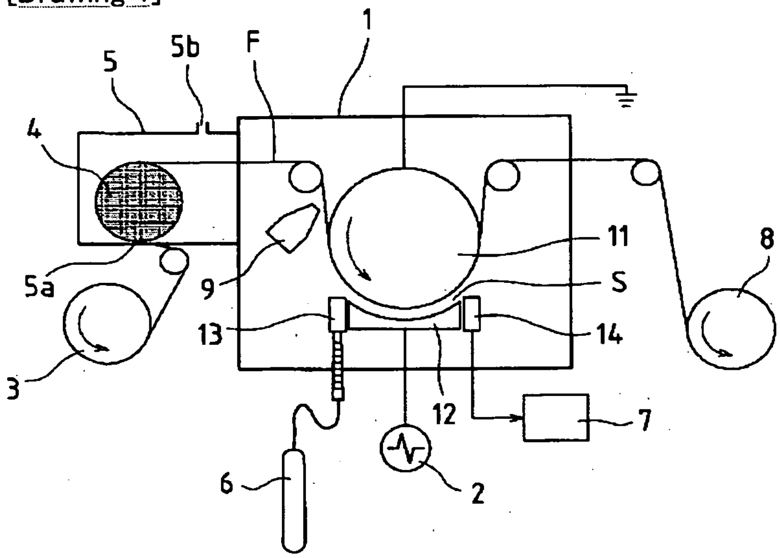
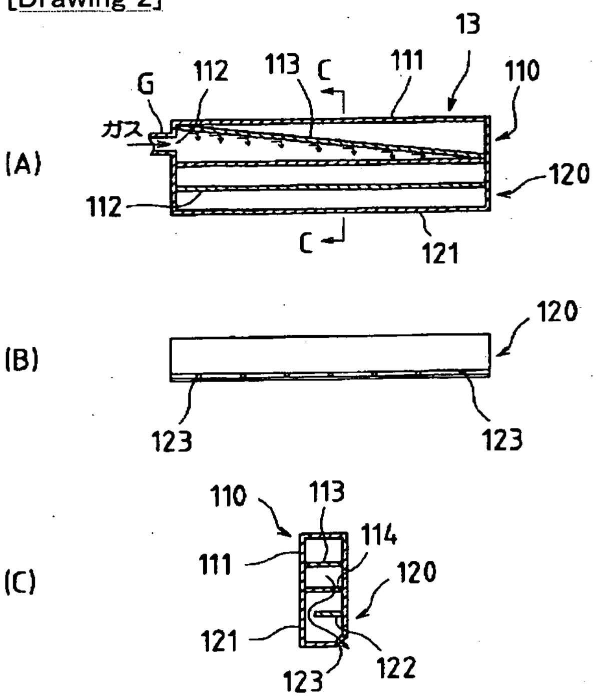
* NOTICES *

DRAWINGS

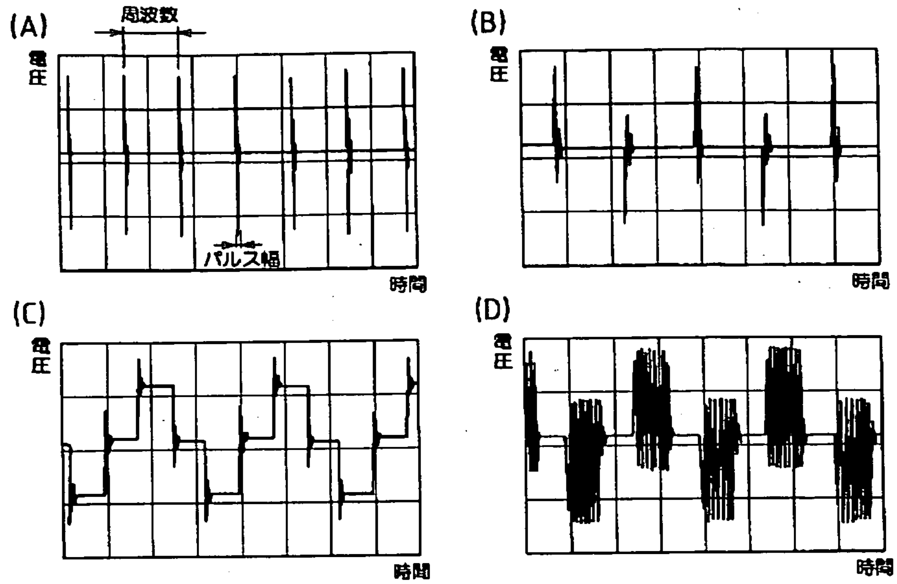
[Drawing 1]



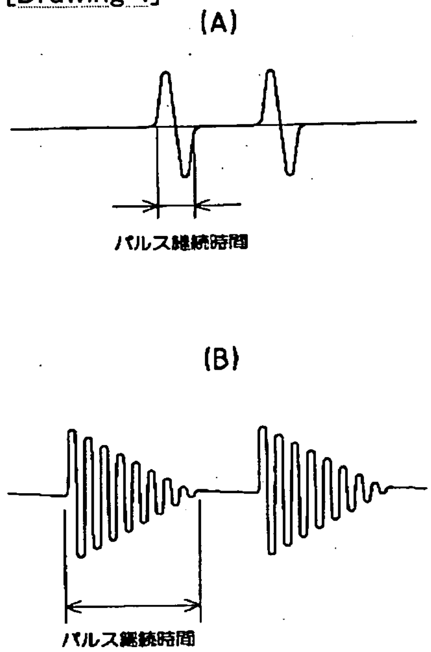
[Drawing 2]



[Drawing 3]



[Drawing 4]



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